CONTAINER WITH EASILY REMOVABLE MEMBRANE LID

BACKGROUND OF THE INVENTION

1. Technical Field

This invention relates to a container having a container opening initially closed by a membrane lid sealed to a flange that encircles the opening.

2. Description of Related Art

Various food and non-food products are packaged in plastic containers or cans formed by blow molding or thermoforming processes. In one such type of container, a flange formed integrally with the container sidewall surrounds the opening of the container. The flange, which can be either a radially inwardly projecting or a radially outwardly projecting flange, provides a surface onto which a flexible membrane closure or lid is attached for initially sealing the container after it is filled with the contents. The consumer peels off the membrane lid to gain access to the contents. If desired, the container can be equipped with an additional overcap for reclosing the container after its initial opening.

The membrane lid is sealed to the container flange using suitable sealant disposed on the lid and on the flange. For example, the lower surface of the lid can have a layer or coating of sealant, and the upper surface of the flange can have a coating of sealant, or the flange itself can be formed of a material that acts as a sealant. In many cases, the sealants are heat-seal materials, and the lid is attached by applying heat and pressure to the lid against the flange to form a seal that extends continuously about the container opening. The seal typically has a substantially uniform bond strength all along its length.

The attachment of the lid to the container must be secure enough to resist inadvertent detachment of the lid during shipping and handling of the container and up until the time that the consumer desires to open it. In the case of food products, it is particularly important that the integrity of the seal remain intact. At the same time, the bond strength of the seal must not be so high that the consumer is unable to peel off the

lid. This would not be a problem if the bond strength could be very accurately controlled. However, with currently available sealants and sealing technology, such accurate control is not possible. This is due in part to the many factors that can affect the bond strength, many of which are not amenable to being accurately taken into account and controlled. As a result, the bond strength can vary substantially from one lid to the next.

The usual solution to this problem is to err on the side of stronger seals, so that the vast majority of the seals produced will be strong enough to resist inadvertent lid detachment under the types of conditions expected to be encountered by the containers. The drawback to this solution is that the stronger of the seals are often so strong that the consumer has difficulty peeling off the lid.

BRIEF SUMMARY OF THE INVENTION

The present invention addresses the above needs and achieves other advantages, by providing a container wherein the seal between the lid and the container does not have a uniform bond strength all along its length. In particular, the seal has at least one portion having a lower bond strength than other portions of the seal. Consequently, initiation of peeling of the lid from the container can begin relatively easily at the lower-strength portion of the seal. Overall, however, the seal can be relatively strong to resist inadvertent detachment of the lid. Once the peeling of the lid is initiated, it becomes relatively easy to completely detach the lid.

A container in accordance with one embodiment of the invention comprises a container body having an opening circumscribed by a flange that defines an outer surface, and a flexible membrane lid sealed to the outer surface of the flange to initially close the opening. The lid is sealed to the flange by a seal formed between a sealant on the lid and a sealant on the flange, the seal extending continuously about the opening, the seal having a width in the radial direction. The seal has a portion of reduced width relative to other portions of the seal such that a peel force required for peeling the lid from the flange has a lower value at the reduced-width portion relative to the other portions of the seal.

The variable seal width in accordance with the invention can be provided in various ways. In some embodiments, the flange has a non-constant width along its length so that when the lid is sealed to the flange, a narrower portion of the flange creates a narrower seal than at other, wider portions of the flange. In other embodiments, the flange can have (but doesn't necessarily have to have) a uniform width along its length, but a sealant is applied to the flange and/or to the membrane in a variable-width pattern so that a narrower portion of the pattern creates a narrower seal than at other, wider portions of the pattern.

In one embodiment, the lid defines a pull-tab portion located in registration with the reduced-width portion of the seal. The pull-tab portion can be grasped and pulled to initiate peeling off the lid.

The sealant on the lid can be any of various materials, including but not limited to polypropylene (with or without mineral filler), ethylene/methacrylic acid copolymer ionomer, ethylene vinyl acetate, high-density polyethylene, low-density polyethylene, ethyl methyl acrylate, metallocenes, and mixtures thereof. The sealant on the flange likewise can be any of these materials. The sealants on the lid and flange can be identical, but do not necessarily have to be; any two sealant materials that are compatible with each other and produce a seal of adequate bond strength can be used. In some embodiments, as noted, the sealant on the flange can be comprised of the material of the flange itself. For instance, where the container is formed of polypropylene, which is a heat-sealable material, a lid having a compatible heat-sealable material can be heat-sealed directly to the flange.

The membrane lid can comprise various materials. Typically, the lid includes a substrate and a layer of sealant laminated to, coated on, coextruded with, or otherwise provided on the substrate. The substrate can comprise a barrier layer, by itself or combined with one or more other layers. The barrier layer can comprise various materials, including but not limited to metal foil, polyethylene terephthalate, modified polyethylene terephthalate, metallized polyethylene terephthalate, metallized modified polyethylene terephthalate, polyethylene naphthalate, metallized polyethylene

naphthalate, metallized polypropylene, metal oxide and silicate coated polyester, metal oxide and silicate coated polypropylene, ethylene vinyl alcohol copolymer, and mixtures thereof.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

Having thus described the invention in general terms, reference will now be made to the accompanying drawings, which are not necessarily drawn to scale, and wherein:

FIG. 1 is a perspective view of a container sealed with a membrane lid in accordance with one embodiment of the invention;

FIG. 2 is a cross-sectional view of the container of FIG. 1;

FIG. 2A is a cross-sectional view through the upper end of the container along line 2A-2A in FIG. 1;

FIG. 3 is a top elevation of the container body of the container viewed from line 3-3 in FIG. 2;

FIG. 4 is a cross-sectional view similar to FIG. 2, showing an alternative embodiment of the invention wherein the container has a radially inwardly projecting flange;

FIG. 5 is a top elevation of a container body in accordance with a further embodiment of the invention, wherein a flange has a sealant applied in a variable-width pattern;

FIG. 6 is a bottom elevation of a membrane lid in accordance with a further embodiment of the invention, wherein a sealant is applied to the membrane in a variable-width pattern;

FIG. 6A is a cross-sectional view through the membrane along line 6A-6A in FIG. 6; and

FIG. 7 is a top elevation of a container body in accordance with yet another embodiment of the invention, having a flange with a cut-out to form a reduced-width portion of the flange.

DETAILED DESCRIPTION OF THE INVENTION

The present inventions now will be described more fully hereinafter with reference to the accompanying drawings, in which some, but not all embodiments of the invention are shown. Indeed, these inventions may be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will satisfy applicable legal requirements. Like numbers refer to like elements throughout.

A container **10** in accordance with a first embodiment of the invention is shown in FIGS. 1, 2, 2A, and 3. The container **10** includes a container body **12** and a flexible membrane lid **14**. The container body **12** can be formed of various materials and in various configurations, and by various processes. Generally, the container body includes a bottom wall **16**, a tubular sidewall **18** having a lower end joined to the outer periphery of the bottom wall, and a flange **20** joined to an upper end of the sidewall. The flange encircles a top opening of the container body. In the instant embodiment, the flange **20** extends radially outwardly from the sidewall. The flange defines a substantially planar upper surface to which the lid **14** is attached to seal closed the top opening of the container body.

With reference to FIG. 2A in particular, the lid **14** is attached to the flange **20** by a sealant **22** disposed on the upper surface of the flange **20** and a compatible sealant **24** disposed on the lower surface of the lid **14**. In this embodiment, the lid has a substrate **26** that provides the necessary strength, tear-resistance, and other desired properties for the lid, and the sealant **24** comprises a layer or coating disposed on the lower surface of the substrate **26**. As shown, the sealant layer **24** covers the entire surface of the substrate **26**, and can be provided in various ways, such as by coextrusion of the substrate and sealant

layers, or by providing separate substrate and sealant webs and then laminating the webs together with an intervening adhesive or tie layer (not shown). Alternatively, the sealant **24** could be applied to only that portion of the substrate **26** that will come into contact with the sealant **22** on the flange **20**, such as by printing the sealant onto the substrate.

The substrate **26** is shown as being a single layer, but alternatively it can comprise two or more layers joined together in any suitable fashion. In some cases, the contents of the container **10** should be prevented from being exposed to moisture vapor and/or oxygen outside the container, and in such cases the substrate generally includes at least one barrier layer that is substantially impermeable to the unwanted substance. The barrier can comprise various materials, including but not limited to metal foil, polyethylene terephthalate, modified polyethylene terephthalate, metallized polyethylene terephthalate, metallized modified polyethylene terephthalate, polyethylene naphthalate, metallized polyethylene naphthalate, metallized polypropylene, metal oxide and silicate coated polyester, metal oxide and silicate coated polypropylene, ethylene vinyl alcohol copolymer, and mixtures thereof.

The sealants **22** and **24** can comprise various materials, including but not limited to glues or adhesives (e.g., hot melt glues, cold seal adhesives, etc.), polypropylene (with or without mineral filler), ethylene/methacrylic acid copolymer ionomer, ethylene vinyl acetate, high-density polyethylene, low-density polyethylene, ethyl methyl acrylate, metallocenes, and mixtures thereof.

The attachment of the lid **14** to the container flange **20** must be strong enough to resist inadvertent detachment of lid from the flange, whether a partial or a complete detachment, under the types of handling, shipping, and storage conditions expected to be encountered by the container. With current conventional sealants and container-manufacturing methods, the bond strength between the lid and container flange can vary significantly as a result of variations in a number of factors that affect bond strength. Thus, some containers may be produced with lid/flange bond strength that is inadequate to prevent failure of the seal under typical conditions. To reduce the incidence of failed seals, therefore, the general practice is to select the sealants and design the container for

stronger seals. The problem with this approach is that there is still a significant variation in seal strength among the produced containers, and the stronger ones of the container seals can be so strong that the consumer has great difficulty peeling off the lid, or cannot peel it off at all.

The present invention addresses this problem. It was noted that the most difficult phase of lid removal is initiating the separation of the lid from the flange. Once an area of the lid is successfully separated from the flange, even if this initial separation requires great force, continued peeling of the lid requires less force and can be accomplished relatively easily. The invention takes advantage of this phenomenon. In accordance with the invention, the seal between the lid and the container flange does not have a uniform width all along the length of the seal. Generally, for a given sealant, the peel force required to peel the lid from the flange is proportional to the surface area of the seal. Thus, a narrower seal tends to require a lower peel force to remove the lid, compared with a wider seal. In containers of the invention, a portion of the seal is relatively narrow compared with other portions of the seal. Accordingly, peeling of the lid from the flange can be initiated at the narrow portion with relatively low peel force. At the same time, however, the overall strength of the lid-flange attachment can be relatively high by virtue of the wider portions of the seal.

The first embodiment shown in FIGS. 1, 2, 2A, and 3 illustrates one way to accomplish the variable-width seal. In this embodiment, the sealant **22** on the flange **20** is applied to substantially the entire planar upper surface of the flange, i.e., over the full radial width of the flange. However, the flange has a variable width, as illustrated in FIGS. 2 and 3. More particularly, in the illustrated embodiment, the flange **20** has a continuously variable width, smoothly varying between a minimum width $\mathbf{W_{min}}$ and a maximum width $\mathbf{W_{max}}$. The locations of the minimum and maximum widths are diametrically opposite each other. The flange **20** can have circular outer and inner peripheries as shown, with the inner periphery being non-concentric with the outer periphery; alternatively, various other flange configurations could be used. When sealant **22** is applied to the entire upper surface of the flange **20** and the lid is sealed to the flange, the resulting seal has a variable width. The portion of the lid sealed to the narrow portion

of the flange has a narrow seal, and initiating of peeling of the lid can be effected at this narrow seal portion with relatively low force.

To facilitate grasping the lid, and also to aid the consumer in starting the lid removal at the proper location, preferably the lid includes a pull-tab portion **28** located in registration with the narrow portion of the seal. The pull-tab portion extends radially outwardly beyond the outer edge of the flange at the narrow portion of the flange; to open the container, the consumer grasps and pulls the pull-tab portion up and toward the opposite side of the container, as shown in phantom lines in FIG. 2. The remainder of the lid preferably does not extend beyond the flange, so that usage of lid material is minimized. Alternatively, it would be possible to size the lid so that it extended beyond the flange about its entire circumference, and a marking could be provided on the lid to indicate where the lid should be grasped and pulled to initiate peeling; however, this arrangement would require great usage of lid material and hence is not preferred.

FIG. 4 illustrates a second embodiment of the invention. The container **10'** in accordance with this embodiment is generally similar to the previously described container, except the flange **20'** projects radially inwardly from the container sidewall **18** instead of radially outwardly.

The objective of providing a seal that has at least one relatively narrow portion can be accomplished in ways other than providing a variable-width flange. For instance, FIG. 5 shows a third embodiment of the invention having a container body **112** that includes a flange **120** of uniform width, but wherein the sealant **122** is applied to the flange in a variable-width pattern. In particular, the sealant covers substantially the full width of the flange over most of the flange's circumference, but over a minor circumferential portion of the flange the sealant covers only part of the width of the flange. The sealant can be applied to the flange in any suitable fashion, such as by printing with a rotogravure cylinder or the like. When a lid (not shown) having a compatible sealant is sealed to the flange **120**, the resulting seal has a narrow portion at which peeling of the lid can be initiated.

FIG. 6 illustrates that the variable-width sealant pattern can be applied to the lid instead of, or in addition to, applying it to the flange. Thus, the lid **114** shown in FIG. 6 has a sealant **124** that is applied to a generally annular outer edge portion of the lid that will be in contact with a container flange. The pattern of the sealant includes a narrow portion adjacent a pull-tab portion **128** of the lid. When the lid is sealed to a flange of a container, the resulting seal has a narrow portion at which peeling of the lid can be initiated. The flange can also have a similar variable-width sealant pattern, or the sealant can be applied to the full width of the flange. It is also possible for the flange material itself to act as the sealant, in the case of heat-sealing; e.g., the flange can be polypropylene and the sealant **124** on the lid can include a polypropylene component so that the lid is directly heat-sealable to the flange. This also is true of the previous embodiment where the flange width is variable for effecting a variable-width seal.

Yet another approach to providing a variable-width seal is depicted in FIG. 7. In this embodiment, the container body **212** can be initially formed with a uniform-width flange **220** as indicated by the dashed line. A cut-out **221** is then formed in a portion of the flange, by cutting with any suitable tool. The flange in the region of the cut-out has a narrower width than the rest of the flange, such that a seal formed at this location is narrower than the rest of the seal.

To achieve a substantial reduction in peel force at one portion of the lid-flange seal, the width of the seal should be reduced by a substantial amount relative to other parts of the seal. Preferably, the width of the reduced-width portion of the seal is at least about 30 percent smaller than the width of the other portions of the seal. Additionally, the circumferential length of the reduced-width portion of the seal affects the peel force required to initiate lid peeling. If the length is too small, then the peel force may still be higher than desired; conversely, if the length is too great, the overall strength of the lid-flange bond may be compromised such that there is a substantially increased risk of inadvertent lid detachment. Preferably, the reduced-width portion should occupy a minority (i.e., less than half) of the total circumferential length of the seal, and more preferably less than about one-third of the total length, but more than about one-tenth of the total length.

The container bodies for containers in accordance with the invention can be formed by various processes. The invention is applicable, for example, to plastic container bodies formed by extrusion blow molding, injection molding, or thermoforming. Although containers of circular cross-sectional shape have been illustrated, it will be recognized that the invention is equally applicable to containers of other cross-sectional shapes, such as square, rectangular, oval, elliptical, etc.

Many modifications and other embodiments of the inventions set forth herein will come to mind to one skilled in the art to which these inventions pertain having the benefit of the teachings presented in the foregoing descriptions and the associated drawings. Therefore, it is to be understood that the inventions are not to be limited to the specific embodiments disclosed and that modifications and other embodiments are intended to be included within the scope of the appended claims. Although specific terms are employed herein, they are used in a generic and descriptive sense only and not for purposes of limitation.